

**THE NATIONAL EXAMINATIONS COUNCIL OF TANZANIA**



**EXAMINERS' REPORT ON THE PERFORMANCE  
OF CANDIDATES CSEE, 2014**

**032 CHEMISTRY  
(For School Candidates)**

**THE NATIONAL EXAMINATIONS COUNCIL OF TANZANIA**



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# Table of Contents

FOREWORD .....	iv
<b>1.0 INTRODUCTION .....</b>	<b>5</b>
<b>2.0 ANALYSIS OF THE CANDIDATES' PERFORMANCE IN EACH QUESTION .....</b>	<b>6</b>
<b>2.1 Section A: Objective Questions .....</b>	<b>6</b>
2.1.1 Question 1: Multiple Choice Items .....	6
2.1.2 Question 2: Matching Items.....	7
<b>2.2 Section B: Short Answer Questions.....</b>	<b>9</b>
2.2.1 Question 3: Laboratory Techniques and Safety; Extraction of Metals.....	9
2.2.2 Question 4: Volumetric Analysis; Matter .....	12
2.2.3 Question 5: Periodic Classification; Non-metals and their Compounds .....	15
2.2.4 Question 6: Compounds of Metals; Matter.....	18
2.2.5 Question 7: Hardness of Water; Chemical Equations.....	19
2.2.6 Question 8: Organic Chemistry; Non-metals and their Compounds .....	22
2.2.7 Question 9: Acids, Bases and Salts; Formula Bonding and Nomenclature.....	24
2.2.8 Question 10: The Mole Concept and Related Calculations .....	26
2.2.9 Question 11: Soil Chemistry; Chemical Kinetics, Equilibrium and Energetics	29
<b>2.3 Section C: Essay Questions.....</b>	<b>32</b>
2.3.1 Question 12: Ionic Theory and Electrolysis; The Mole Concept and Related Calculations	32
2.3.2 Question 13: Pollution .....	35
<b>3.0 CONCLUSION AND RECOMMENDATIONS.....</b>	<b>38</b>
<b>3.1 Conclusion .....</b>	<b>38</b>
<b>3.2 Recommendations .....</b>	<b>40</b>
Appendix.....	41

## FOREWORD

The Examiners' Report on the Performance of Candidates in Chemistry subject in the Certificate of Secondary Education Examination (CSEE) 2014 was prepared in order to provide feedback to students, teachers, parents, policy makers and the public in general on the performance of candidates in the subject.

The Certificate of Secondary Education Examination marks the end of four years of secondary education. It is a summative evaluation which among other things shows the effectiveness of education system in general and education delivery system in particular. Essentially, candidates' responses to the examination questions is a strong indicator of what the education system was able or unable to offer to students in their four years of ordinary level secondary education.

The analysis presented in this report is intended to contribute towards understanding of some of the reasons behind the performance of candidates in Chemistry subject. The report highlights some of the factors that made candidates score average marks in this paper. Such factors include general lack of knowledge in relation to a particular concept, failure to interpret the requirement of the questions, poor language command and inability to answer questions which demand explanation or balanced chemical equations. The feedback provided will enable the educational administrators, school managers, teachers and students to identify proper measures to be taken in order to improve candidates' performance in future examinations administered by the Council.

The National Examinations Council of Tanzania will highly appreciate comments and suggestions from teachers, students and public in general that can be used for improving future Examiners' Reports.

The Council would like to thank Examination officers, Examiners and all others who participated in the preparation of this report. We would like also to express sincere appreciation to all the staffs who participated in analyzing the data used in this report.



Dr. Charles E. Msonde  
**EXECUTIVE SECRETARY**

## 1.0 INTRODUCTION

This report analyses the performance of school candidates who sat for the Certificate of Secondary School Education Examination (CSEE) 2014 in 032/1 Chemistry 1. The paper was set according to the examination format which was derived from 2010 chemistry syllabus for Secondary Education.

The paper consisted of three sections, namely A, B, and C. Section A consisted of two objective questions (multiple choice and matching items), section B had nine short answer questions and section C comprised of two essay questions. All questions were compulsory. Each item in section A carried 1 mark while in sections B and C, each question carried a weight of 6 and 13 marks respectively.

A total of 137,511 candidates sat for Chemistry examination, out of which 77,989 candidates (56.73%) passed the examination. Statistics show that, the performance has increased by 6.52 percent when compared to 50.19 percent who passed in CSEE 2013 where 144,651 candidates sat for the examination.

This report provides the analysis of the candidates' performance in each question. For each question, an overview of what candidates were required to do and possible reasons for the observed performance is provided. In the analysis, a question is categorized as poor, average or good performed if the percentage of the candidates who scored 30 percent or above of the marks allocated to a particular question is 0-29%, 30-49% and 50-100% respectively.

The following sections indicate the analysis of candidates' performance in each individual question.

## **2.0 ANALYSIS OF THE CANDIDATES' PERFORMANCE IN EACH QUESTION**

### **2.1 Section A: Objective Questions**

#### **2.1.1 Question 1: Multiple Choice Items**

Question one (1) consisted of ten (10) multiple choice items composed from various topics of the chemistry syllabus. Candidates were required to choose the correct response from the given five alternatives and write its letter beside the item number in the answer booklet. Each item carried one (1) mark.

Many candidates (97.9%) attempted this question and the general performance was good as majority (73.7%) scored 3.0 or above out of 10 marks allocated to this question. The percentage of candidates who scored 0 to 2 marks was 26.3 while of those who scored 3 to 4 marks was 40.0 percent. A good number (33.7%) of the candidates scored 5 to 10 marks of which 24.6 percent scored 5 to 6 marks and 9.1 percent scored 7.0 to 10 marks.

Items number (i), (vi) and (viii) appeared to be difficult to most candidates. Item (i) required the candidates to choose from the given five alternatives, the group and the period for an element with atomic number 18. In order to answer this item correctly, the candidate should have sufficient knowledge in electronic configurations of the first 20 elements in the periodic table. This knowledge was necessary in finding the total number of shells in the element with atomic number 18 and electrons present in its outermost shell. A good number of candidates had problems to locate the required element in the periodic table. The correct response was B (group 0 and period 3).

Item (vi) required the candidates to choose the nature of the resulting mixture, when  $10\text{ cm}^3$  of  $0.4\text{ M NaOH}$  are added to  $40\text{ cm}^3$  of  $0.2\text{ M HCl}$ . This item involved calculations to find the number of moles present in  $10\text{ cm}^3$  of  $0.4\text{ M NaOH}$  and in  $40\text{ cm}^3$  of  $0.2\text{ M HCl}$  and then to compare the two reagents. Since their reacting ratio is 1:1, the one with excess number of moles would determine the acidity or alkalinity of the resulting solution. The correct response was D (Acidic) because on calculation, the number of moles of HCl was in excess compared to that of NaOH. Majority of candidates opted for A (Neutral); probably, they thought that because the reaction involved an acid (HCl) and a base (NaOH) then neutralization would take place and therefore the resulting mixture would be neutral.

Item (viii) tested the candidates on the knowledge of mole concept. Candidates were required to choose the most concentrated solution from the given solutions. In order to attempt this item correctly, the candidates were supposed to find the number of moles for each of the given alternatives and then select the one with the largest number of moles. The correct alternative was C (65 g of potassium nitrate in  $100\text{ cm}^3$  of water). However, candidates opted for any alternative indicating poor mastery of application of mole concept.

### **2.1.2 Question 2: Matching Items**

The question consisted of two Lists, namely A and B. List A comprised of ten (10) items, which were to be matched with ten correct responses in List B, by writing the letter of the correct response beside the item number in List A. This question was based on five (5) related topics namely; Compounds of Metals, Periodic Classification, Hydrogen, Non-metals and their Compounds and Extraction of Metals.

The question was attempted by 136,793 (97.5%) candidates and the general performance was poor because it is only 27.0 percent of the candidates who managed to score 3 marks or above out of the 10 marks. Out of 73.0 percent of the candidates who scored below 3 marks, 53.8 percent scored 0 to 1 marks and 19.2 percent scored 2 marks. On the other hand, the percentage of candidates who scored 5 marks or above was 7.7 of which only 0.2 percent scored 9 to 10 marks.

Items number (i), (iv), (v), (ix) and (x) were wrongly matched by most candidates. Item (i) required the candidates to find an item from list B which matched with the phrase, "Its nitrate decomposes to the metal, nitrogen dioxide and oxygen". However, most candidates matched it wrongly with either "copper" or "lead". The candidates' responses to this item are contrary to the correct answer because nitrates of copper and lead decompose on heating to the oxide of the metal, nitrogen dioxide and oxygen. The correct response here was T (Silver).

Item (iv) which read "Has maximum valency of five" had various incorrect matches by candidates. The candidates didn't know that, it is only nitrogen and phosphorus among the first 20 elements of the periodic table which have the ability of exhibiting a covalency of 5. Hence, the correct response from list B is S (phosphorus) which has the ability of sharing 5 electrons in the formation of bonds.

Item (v) which read as "Burn with lilac colour flame", had incorrect matching by most of the candidates. This is an indicator that candidates lacked practical skills in the laboratory on flame test of common metals. The correct response in this item was A (Potassium). Items (ix) (the second abundant element in the earth's crust) and (x) (reacts with steam only at red

heat to produce metal oxide and hydrogen gas) were also difficult to most candidates as they matched them wrongly. This failure indicates that, candidates lacked thorough knowledge on these topics, particularly, Periodic Classification, Compounds of Metals and Non-metals and their Compounds. However, the correct responses were I (Silicon) and J (Zinc) respectively.

## **2.2 Section B: Short Answer Questions**

### **2.2.1 Question 3: Laboratory Techniques and Safety; Extraction of Metals**

This question consisted of parts (a) and (b) with sub-items. In part (a) the candidates were required to explain why chemistry laboratory exits open outwards and to state the use of any four items found in a First Aid Kit. Part (b) (i) required the candidates to arrange the metals; zinc, magnesium, calcium, copper and mercury in the order of increasing reactivity. In part (b) (ii), the candidates were required to identify from among the metals listed in (b) (i), the one which reacts with steam to form an oxide which is white when cold and yellow when hot.

The question was attempted by majority (95.7%) of the candidates and out of which 78.3 percent scored 2 or above out of 6 marks, implying that it is only 21.7 percent who scored below 2 marks. The candidates who scored 2.5 to 4 marks were 47.7 percent while those who scored 4.5 to 6 marks were 23.5 percent. This trend indicates good performance in this question.

The candidates who had high marks managed to offer correct responses to all sub-items of the question. They managed to state that laboratory exits open outwards so as to enable easier and quick escape in case of accident; they also managed to state the use of items found in a First Aid Kit. Not

only that, they succeeded to arrange the given metals in the order of increasing reactivity and finally, identified zinc as a metal which forms oxide which is white when cold and yellow when hot. Extract 3.1 shows a sample of a good response from one of the candidates.

### Extract 3.1

3. a) i) Chemistry laboratory exists open outwards in order to allow odour gases out of the room and help a person easily escape from the room whenever there is a laboratory accident.

ii) - A razor blade and a pair of scissors, used to cut the dressing materials such as bandages when dressing a wound to a victim.

- Pain killers are used to reduce pain for an injured person.
- Soap is used to wash hands before and after giving first aid to avoid contamination of microorganisms
- Adhesive bandages are used to cover a wound to avoid direct contamination of bacteria and other microorganisms.

b) i) Mercury  
Copper  
Zinc  
Magnesium  
Calcium

Increasing reactivity series.

ii) Zinc reacts with steam to form an oxide which is white when cold and yellow when hot.

Extract 3.1 shows a good response in which the candidate managed to score good marks. The candidate provided one of the reasons for the laboratory exits to open outwards. Similarly, he/she stated the

functions of items in the First Aid Kit and finally, arranged the metals serially as the question instructed.

On the other hand, a few candidates who had moderate scores performed well in part (a), but had problems of arranging the given elements in the order of increasing reactivity in part (b). The analysis made noted that, other candidates had sound knowledge about reactivity series but they misunderstood the requirement of the question, that metals should be arranged in the order of increasing reactivity and not vice versa.

The candidates who scored zero mark could not give any answer which was correct. Majority resorted to guess work which resulted into wrong responses while others only copied the question and left it unanswered indicating that they didn't comprehend the subject matter. Extract 3.2 shows a sample response from one of the candidates who had inadequate knowledge about the topics in question.

### Extract 3.2

3a	Because some the chemical will reaction of air but does not open because will separation of Air and to effect the body
3	a ii) i/ It helped people for the accident. ii/ It helped people does not die.
3	b) Magnesium, Calcium, Copper, Mercury and Zinc.
3	b ii) Copper.

In part (a) of Extract 3.2, the candidate wrote the meaningless sentences indicating that the candidate not only lacked the subject content knowledge but also has a problem of expressing his/her ideas using English Language. In part (b) the candidate did not

show the direction of how the metals are arranged, though the metals are not in a correct order.

### 2.2.2 Question 4: Volumetric Analysis; Matter

Part (a) of this question required the candidates to calculate the concentration of sodium hydroxide in moles per  $\text{dm}^3$  when  $20 \text{ cm}^3$  of a solution containing  $7 \text{ g dm}^{-3}$  of sodium hydroxide were exactly neutralized by  $25 \text{ cm}^3$  of  $0.10 \text{ M}$  hydrochloric acid. In part (b) the candidates were required to give two examples of gaseous solution and two examples of solid solution.

The percentage of candidates who attempted this question was 92.6 and out of which 43.0 percent scored 2 or above out of 6 marks while 57.0 percent scored 0 to 1.5 marks. The statistics show that, 34.3 percent of the candidates scored 0 while it is only 1.5 percent who scored 4.5 to 6.0 marks. However, the trend shows that the performance was average.

Candidates who scored high marks managed to calculate correctly the molar concentration of sodium hydroxide in part (a). Some of candidates used the relation ' $Molarity = \frac{\text{concentration g/dm}^3}{\text{molar mass g/mol}}$ ', and substitute the given data; while others wrote a balanced reaction equation between sodium hydroxide and hydrochloric acid, then applied the *dilution law*, where both of the methods led them to the correct answer. Moreover, they gave correct examples of gaseous and solid solutions in part (b). Extract 4.1 shows a sample response in this category.

## Extract 4.1

4	<p>Q Data given</p> <p>Volume of base = <math>20\text{cm}^3</math> (<math>V_B</math>)</p> <p>Volume of Acid = <math>25\text{cm}^3</math> (<math>V_A</math>)</p> <p>Molarity of Base = ? (<math>M_B</math>)</p> <p>Molarity of Acid = <math>0.1\text{M}</math></p>
	<p>From the balanced chemical equation</p> $\text{NaOH} + \text{HCl} \rightarrow \text{NaCl} + \text{H}_2\text{O}$ <p style="text-align: center;">(aq)    (aq)            (aq)    (l)</p>
	<p>Number of moles of Base (<math>n_B</math>) = 1</p> <p>number of moles of Acid (<math>n_A</math>) = 1</p>
	<p>By using</p> $\frac{M_A V_A}{M_B V_B} = \frac{n_A}{n_B} \quad \text{but } n_A = n_B = 1$
	<p>then</p> $M_B = \frac{M_A V_A}{V_B} = \frac{0.1 \times 25}{20} = \frac{0.5}{2} = \frac{5}{40}$
	<p><math>\therefore M_B = 0.125\text{M}</math></p>
	<p>but concentration of NaOH in moles per <math>\text{dm}^3</math></p> <p>= Molarity = <math>\frac{\text{concentration}}{\text{molar mass}}</math> but <math>M_{\text{NaOH}} = 40</math></p>
	<p><math>\therefore</math> concentration (<math>\text{mol}/\text{dm}^3</math>) = <math>0.125 \times 40</math></p> <p>= <math>5\text{mol}/\text{dm}^3</math></p>
	<p>(5) (i) gaseous solution examples are <u>Water gas</u> and <u>producer gas</u></p>
	<p>(ii) Solid solution examples are <u>BRONZE</u> and <u>BRASS</u></p>

In extract 4.1, the candidate wrote a correct balanced reaction equation between HCl and NaOH, then applied dilution law and finally, calculated correctly the concentration of sodium hydroxide in moles per  $\text{dm}^3$ . Similarly, correct examples of gaseous and solid solutions were given.

On the other hand, majority of the candidates who scored averagely, attempted correctly part (a), but faced difficulties in attempting part (b) which was from the topic of matter. The analysis of the responses showed that, some candidates had wrong concept that, solution should only be in a liquid form and not in the gaseous or solid forms; forgetting that, solutions like producer gas and metal alloys are in the gaseous and solid forms respectively. Failure of candidates in this part could be due to narrow understanding of the actual meaning of the term “solution”. The response in the Extract 4:2 is a sample from poor answers to this question.

#### Extract 4:2

4	(a) <u>solution</u>
	<u>Data</u>
	20 cm <sup>3</sup> of solution
	7 g dm <sup>3</sup> of sodium hydroxide
	25 cm <sup>3</sup> of 0.10 m hydrochloric acid
	Required: Moles per dm <sup>3</sup>
	<u>Formulae</u> : solution + sodium hydroxide hydrochloric acid
	20 cm <sup>3</sup> + 7 g dm <sup>3</sup> = 27 g dm <sup>3</sup>
	25 cm <sup>3</sup> → 25
	1.04
	25   27      1.04 g dm <sup>3</sup>
	25
	200
	200
	---

	$1.04 \text{ g dm}^{-3}$ into $\text{dm}^3$
	$1 \text{ g} = 100 \text{ dm}$
	$1.04 \text{ g} = ? \text{ dm}$
	$\frac{1.04 \times 100}{1}$
	$1.04$
	$\times 100$
	$000$
	$000$
	$10400$
	$07$
	$104$
	$1104$
	$104.00$
	$\therefore$ concentration is $104 \text{ dm}^3$

4 (B)	Gaseous solution
	Example: Oxygen, hydroxide.
	" solid solution
	Example: water and salt.

In Extract 4.2 the candidate applied incorrect formula to calculate the concentration of sodium hydroxide. Moreover, he/she wrote concentration in  $\text{dm}^3$  instead of moles per  $\text{dm}^3$ . She/he failed to write examples of gaseous and solid solutions as demanded in part (b).

### 2.2.3 Question 5: Periodic Classification; Non-metals and their Compounds

In part (a) of the question, the candidates were provided with a sketch of a part of a periodic table which comprised of periods 1, 2 and 3 with some elements missing. The candidates were then required to list down the names of all missing elements. Part (b) required the candidates to write the reaction equations involved in the industrial manufacture of sulphuric acid in the contact process starting with sulphur dioxide. Furthermore, they were demanded to explain why sulphur trioxide is not dissolved directly in water to obtain sulphuric acid in contact process.

Many candidates (92.2 %) responded to this question and out of which 74.4 percent scored 2 marks or more out of 6 marks. High percent (64.9%) scored 2.5 to 3.5 marks and a few (5.2%) scored 4 to 6 marks out of which 0.5 percent scored all 6 marks. These statistics show that, the question was good performed.

The candidates who scored high marks succeeded to list correctly the names of all missing elements. Similarly, they managed to write balanced reaction equations involved in the manufacture of sulphuric acid in the contact process with their state symbols, and finally, explained why sulphur trioxide is dissolved in concentrated sulphuric acid and not directly in water as seen in Extract 5:1.

### Extract 5:1

5	a) Name of the missing elements
	i/ Carbon.
	ii/ Nitrogen
	iii/ Oxygen.
	iv/ Neon
	v/ Sodium.
	vi/ Magnesium.
	b) i/ $2\text{SO}_2 + \text{O}_2 \longrightarrow 2\text{SO}_3$
	(g) (g) (g)
	$\text{SO}_3 + \text{H}_2\text{SO}_4 \longrightarrow \text{H}_2\text{S}_2\text{O}_7$
	(g) (l) (l)
	$\text{H}_2\text{S}_2\text{O}_7 + \text{H}_2\text{O} \longrightarrow 2\text{H}_2\text{SO}_4$
	(l) (l) (aq)

5	b) i/ Sulphur trioxide is not dissolved directly in water to obtain sulphuric acid in contact process because their <del>water</del> would be formation of fumes of sulphuric acid since the reaction is exothermic therefore making it difficult to collect the acid.
---	--

In Extract 5.1, the candidate presented accurately the responses according to the requirement of the question. Proper names of all the missing elements are written and she/he presented all necessary equations involved in the industrial manufacture of sulphuric acid in contact process.

On the contrary, majority of the candidates who scored low marks listed the elements by using symbols instead of names as instructed in part (a). Furthermore, they responded partially to part (b) (i) by writing unbalanced chemical equations and failed to give the correct formula of *oleum* as  $H_2S_2O_7$  leading to incorrect equation for the last step i.e.  $H_2S_2O_7(aq) + H_2O(l) \rightarrow 2H_2SO_4(aq)$ . Moreover, they failed to reason out that sulphur trioxide is not dissolved directly in water to get sulphuric acid because the reaction between sulphur trioxide and water is highly exothermic; hence, the heat so formed vaporizes the sulphuric acid formed. Extract 5.2 shows a sample of poor responses.

### Extract 5.2

5	@ C, N, O Ne K, Mg
	(b) (i) Hydrochloric acid
	(ii) Sulphuric acid not dissolved directly in water because many sulphur atoms of electron so that sulphuric acid it can not dissolved in water with out separately electron

In extract 5.2, the candidate used symbols instead of names of missing elements. In b (i) she/he wrote hydrochloric acid instead of sulphuric acid in contact process showing that she/he was not careful in following the instructions of the question.

#### 2.2.4 Question 6: Compounds of Metals; Matter

In part 6(a) of this question, the candidates were demanded to explain with the aid of chemical equations what will happen when aluminium chloride reacts with water. Part (b) stated that “A student accidentally broke a beaker containing copper (II) sulphate crystals. He decided to separate the blue crystals from the small pieces of glass by first dissolving the mixture and then filtering. What were his next steps?”

About three quarters (75.7%) of the candidates responded to this question and 80.6 percent scored 0 out of 6 marks while only 0.8 percent scored above 2 marks. Very few (0.03%) candidates scored all 6 marks.

Candidates who scored zero marks failed completely to explain what happens when aluminium chloride reacts with water. In the same way, they lacked appropriate skills in *separation of mixtures* hence failed to list the appropriate steps to be followed in order to obtain crystals of copper sulphate. For example, some candidates managed to write reacting substances in part (a) but ended up with incorrect products (see Extract 6.1).

A few candidates who scored partial marks encountered difficulties in part (b). They were able to write only one step which was “evaporation of the solution so as to concentrate it” and they could not proceed further. However, a few candidates who scored high marks responded correctly to part (a) of the question and then listed all of the required steps to retrieve

the copper sulphate crystals in part (b). Extract 6.2 shows a good answer from one of the candidates who managed to answer part (a) correctly.

### Extract 6.1

6a	$AlCl_3 + H_2O \rightarrow AlO + 3Cl + H_2$
	The reaction will produce Free Chlorine, aluminium Oxide and Hydrogen gas.

What is written in Extract 6.1 is an indication that the candidate had insufficient knowledge on the asked concepts of compounds. She/he could neither write nor explain equation for the reaction between aluminium chloride and water. Furthermore, part (b) of the question was left unattempted.

### Extract 6.2

6	When aluminium chloride reacts with water it forms
(a)	an insoluble hydroxide of aluminium hydroxide as white precipitate and white fumes of a colourless gas of hydrogen chloride.
	$Al(Cl)_{3(aq)} + 3H_2O_{(l)} \rightarrow Al(OH)_3_{(s)} + 3HCl_{(g)}$

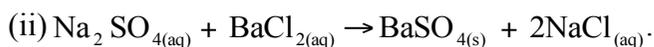
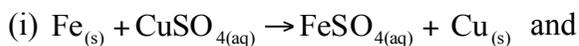
In Extract 6.2, the candidate wrote and explained correctly the reaction of aluminium chloride with water. The equation is well balanced and all state symbols are correctly indicated.

## 2.2.5 Question 7: Hardness of Water; Chemical Equations

In part (a) the candidates were provided with information about ionic compositions of water samples from wells in Kahama, Maswa and Bukombe districts as shown in the following table:

Ions	Mineral content of water in mg per litre		
	Kahama	Maswa	Bukombe
Calcium, Ca <sup>2+</sup>	28	82	18
Magnesium, Mg <sup>2+</sup>	14	41	13
Chloride, Cl <sup>-</sup>	53	7	22
Sodium, Na <sup>+</sup>	7	143	39
Hydrogencarbonate, HCO <sub>3</sub> <sup>-</sup>	281	5	93
Sulphate, SO <sub>4</sub> <sup>2-</sup>	2	14	16

Candidates were then required to; (a) (i) state two ways in which these ions get into the samples of water, (ii) state with reasons the hardest sample of water and (iii) state two ways that can be used to remove the ions in the hardest sample. Part (b) of the question required the candidates to state and describe the type of reaction in the chemical equations



A good number (79.9 %) of candidates attempted this question but the overall performance was poor because a large number of the candidates (73.2%) scored below 2.0 marks out of 6, among which 46.3 percent scored 0 marks. A few (26.1 %) scored from 2.0 to 4.5 marks while the minority (0.7 %) scored 5 to 6 marks, out of them only 0.1 percent scored all 6 marks.

Part (a) of the question which was from the topic of ‘Hardness of Water’ was skipped by most candidates and majority of candidates who attempted it, performed poorly. It was observed that, the candidates could not interpret correctly the data of the water samples from the three sources. They failed to state ways in which ions which cause hardness of water get into water bodies. Besides, they could not spot that a sample from Maswa contained high concentration of Ca<sup>2+</sup> and Mg<sup>2+</sup> ions which are responsible

for hardness of water; therefore, it was the hardest sample. Likewise, they failed to state the ways of removing hardness from this water.

Part (b) was attempted by a good number of candidates but most of them did not understand the requirement of the question which was specifically to state and describe the type of reactions represented by given equations. Many candidates were just stating without describing. For example, they just write the responses; “displacement” and “double decomposition” with no description.

A few candidates who scored high marks made a correct interpretation of the given water samples: they stated clearly the ways in which the ions in the question get into the samples of water and then stated with reasons the hardest sample. Additionally, they described correctly the type of reactions represented by the given equations. Extract 7 displays a sample of a response of a candidate in this category.

### Extract 7

7a.	ii) Maswa water because
	a) It has high content of $\text{Ca}^{2+}$ and $\text{Mg}^{2+}$ in its water
	b) It has highest content of $\text{SO}_4^{2-}$ which cause permanent hardness of water.
	iii) - By adding sodium carbonate.
	- By ion exchanger method in industries.
b)	i) Displacement reaction because Iron has displaced Copper from its salt to form Iron sulphate.
	ii) Precipitation reaction because the Two aqueous solution of Sodium and Barium reacted to form one soluble salt and insoluble salt of Barium sulphate.

Extract 7 shows a good response of a candidate who presented accurately the answers to all items in the question. The candidate managed to score full mark.

### 2.2.6 Question 8: Organic Chemistry; Non-metals and their Compounds

In part 8 (a), the candidates were given the general structural formula of three organic compounds;  $R-OH$ ,  $R-COOH$  and  $R-COOR^1$ . They were required to name the homologous series represented by these compounds and the functional groups represented by  $R-OH$  and  $R-COOH$ . Part (b) described an experiment in which the flame went out when a burning splint was introduced into a gas jar containing carbon dioxide. Candidates were then required to mention two properties of carbon dioxide which were illustrated from the given experiment. Finally, they were asked to name the equipment which is widely used in everyday life which makes use of the two properties.

About two thirds (68.8 %) of the candidates attempted this question, out of which 77.4 percent scored below 2 marks. Candidates who scored 2 to 6 marks were 22.4 percent, of which 15.0 percent scored 2 to 3 marks whereas 7.6 percent scored above 3 marks, a trend which indicates a poor performance.

The candidates who had low scores, and in particular those who scored a 0 mark failed to name the homologous series of the compounds. In the same way, they faced difficulties in identifying functional groups of alcohol and carboxylic acids. Some assumed R- is a part of the functional group and therefore included it into the formula of functional groups as  $R-OH$  and  $R-COOH$  while others confused functional groups with uses of these

compounds and listed uses of alcohols and carboxylic acids. This indicates inadequate knowledge about functional groups in organic compounds.

In responding to part (b), many candidates failed to recognize that, since the burning splint was extinguished, then carbon dioxide does neither burn nor support combustion as the properties of this gas, instead, some stated that, carbon dioxide is used as fire extinguisher. Extract 8.1 is a sample of the answer in which a candidate low marks.

### Extract 8.1

8(a)(i)	R COOR (Homologous series are:)
	Methanoate
	Ethanoate
	Propanoate
	Butanoate
	Pentanoate
	Hexanoate
	Heptanoate
	Octanoate
	Nonanoate
	Decanoate
8(a)(ii)	Functional group of R-OH is <u>Alcohol</u>
	Functional group of R-COOR is <u>Carboxylic acid</u> .
8.(b)(i)	1) Combustible effect.
	2) Cooling effect.
(ii)	Engine of Cars.

Extract 8.1 shows a response which made the candidate score a 0 mark. The candidate listed esters in the order of increasing carbon number instead of homologous series of the given compounds. He/she failed to give correct names of the functional groups and similarly, could not give the required property and use of carbon dioxide.

However, the few candidates (0.3%) who managed to score high marks responded correctly in part (a) by naming correctly the homologous series and functional groups of the given compounds. They also managed to list the two properties of carbon dioxide and named the type of equipment used in everyday life to make use of the two mentioned properties in part (b) as illustrated in the Extract 8:2.

### Extract 8:2

8 a)	
i)	R-OH = Alcohol R-COOH = Carboxylic acids. RCOOR' = Esters.
ii)	R-OH = Hydroxyl group. P-COOH = Carboxyl group.
8 bi)	Carbondioxide does not support combustion. Carbondioxide is denser than air
ii)	Fire extinguisher.

In Extract 8.2 the candidate presented concisely what was required by the question.

### 2.2.7 Question 9: Acids, Bases and Salts; Formula Bonding and Nomenclature

Part (a) of the question demanded the candidates to differentiate between a base and an alkali, then atom and isotope. Part (b) demanded them to calculate the molecular formula of a compound 'P' which has vapour density of 23 and percentage compositions by mass of the elements present as 52.2% carbon, 13% hydrogen and 34.8% oxygen respectively. Finally,

they were required to write the possible isomer(s) of the molecular formula they determined.

A total of 126,714 (90.3%) candidates attempted this question. The percentage of candidates who scored 0 to 1.5 marks was 56.6 while the percentage of those who scored 2.0 to 6 marks was 43.4. A few (0.8 %) candidates scored all 6 marks. However, this trend indicates average performance in this question.

Candidates who performed well were very conversant with the difference between a base and an alkali; an atom and isotope and calculated properly the empirical formula and its respective molecular formula. In addition, they wrote correctly all the possible isomers from the molecular formula they determined.

On the other hand, the candidates who scored partial marks managed to give the differences of the terms in part (a) and also were knowledgeable on the steps of calculating the empirical formula in (b). However, they stuck in the calculation of molecular mass from vapour density and hence unable to draw correct structural isomers. Conversely, the candidates with poor performance failed to respond correctly to either part of the question as the response which is shown in Extract 9.

## Extract 9

9.	Differentiate between.	
	(i) A base and an alkali.	
	(ii) Atom and isotopes	

	A base	An Alkali
	This is something which is showing parts of an object	This is the way or types in arranging the organic numbers.
	Atom	ISOTOPES
	This is the process of an substance to have the avogadro's number	This is the way of group grouping the alkane, alkyl and etc.

6)	An organic compound P consists of 52.2% carbon, 13% of hydrogen and 34.8% of oxygen. Calculate the vapour density of P is 23. Calculate the molecular formula of the compound P and write possible isomer(s) from the molecular formula.
	Soln.
	data given
	52.2% carbon
	13% hydrogen
	34.8% oxygen
	density of P 23

Although the answers in the Extract 9 are presented clearly, they are all wrong. The candidate did not manage to give a correct difference to even a single pair of the terms in 9 (a). The candidate ended up with copying part (b) of the question and writing the given data without performing any calculation.

### 2.2.8 Question 10: The Mole Concept and Related Calculations

The question tested the candidates' ability on application of the mole concept and related calculations. In part (a), the candidates were required to

calculate the mass in grams of potassium chlorate which would be heated to produce enough oxygen needed to react with aluminium to produce 5.1 g of aluminium oxide. In part (b) the candidates were required to find how many moles of HCl are needed to react with 25 g of  $\text{MnO}_2$  in the preparation of chlorine gas represented by the following equation:  
$$\text{MnO}_2 + 4\text{HCl} \rightarrow \text{MnCl}_2 + 2\text{H}_2\text{O} + \text{Cl}_2$$

Analysis shows that, about half (58.6 %) of the candidates attempted this question and out of which majority (87.2 %) scored below 2 marks of which 66.0 percent scored a 0 mark. The candidates who managed to score 3 to 6 marks were only 4.6 percent out of which is only 0.5 percent who scored all 6 marks.

Majority of the candidates who scored low marks in this question, faced difficulties in writing and balancing chemical equations of the reaction between aluminium and oxygen and also thermal decomposition of potassium chlorate which were necessary from which the subsequent calculations should base. A few candidates who managed to write the stated equations failed to correlate the amount of oxygen required to produce 5.1g of aluminium oxide with the amount produced by potassium chlorate and hence, performed unsuccessfully the calculations involved.

Likewise, in part (b), most of the candidates were unable to relate number of moles and mass in grams and thus resorted on performing irrelevant calculations or left the question item undone which indicate that, candidates had poor mastery of application of mole concept. Extract 10:1 provides a sample answer from the script of a candidate with weak performance.

### Extract 10:1

10. ~~Aluminium reacts with oxygen to form aluminium oxide. How many grams of potassium chlorate would be heated to produce enough oxygen to form 5.1g of aluminium oxide?~~  
- When a reacts with oxygen to form aluminium oxide. It will occur 5.2 grams of potassium chlorate would be heated to produce enough oxygen to form 5.1g of aluminium oxide. and we can show how the sulphuric acid will contain in the relation of another incomplete. By the way the Aluminium reacts with oxygen. When two ways of conducted of another preparation in our occur that deal in the phenomena.

by The preparation of chlorine gas can be represented by the following equation:-  
$$\text{MnO}_2 + 4\text{HCl} \rightarrow \text{MnCl}_2 + 2\text{H}_2\text{O} + \text{Cl}_2$$
  
How many moles of HCl are needed to react with 25g of  $\text{MnO}_2$ ?  
Soln  
The moles that can difficult to experiment in the cussion we have not enough emit and molar mass of this experiment can take easily in the found direction. If the moles react with another solution will contain in supervisor of the density occur between the way.

In extract 10.2, the candidate failed to perform any calculation, instead, he/she provided a disorganized description which did not suit the demand of the question.

On the contrary, the candidates who scored high marks managed to write all necessary equations and made appropriate relations of number of moles



C. They were also required to write down the type of reaction represented by the energy profile diagram.

A good number (83.8%) of candidates attempted this question and statistics show that, 82.0 percent scored 0 to 1.5 marks; 17.8 percent scored 2 to 4.5 marks while only 0.2 percent scored 5 to 6 marks, a trend that shows a general poor performance.

The analysis of the responses from the candidates noted that, part (a) of the question was the most poorly performed. Many candidates failed to list specific effects caused by excessive nitrogen on plants, or stated ways by which soil nitrogen can be lost. For example, in one of the candidate's script, he/she wrote:

*11(a)(i) "leads to yellowish of leaves; increases soil acidity; increases photosynthesis process; makes the soil to loose its fertility" (ii) "By soil pollution; By land degradation through monoculture".*

In other cases, the candidates listed deficiency effects instead of excessive effects of nitrogen to plants, contrary to the requirement of the question. Such inaccurate and unclear answers are among the examples which show that the candidates lacked the knowledge of plants nutrients or did not learn them at all and therefore resorted to writing anything regardless of whether it was related to soil nitrogen. A similar response is presented in Extract 11 as an example from the candidates who performed poorly.

## Extract 11

11(a)(i)	<ul style="list-style-type: none"><li>- it is resulted to the unfertile soil</li><li>- it can undergo to change the colour of the plant from green to purple</li><li>- The result of nitrogen to plant is the plant it can lose the some important nutrients for example the starch and lipids.</li><li>- The plant it can not able to grow well, it is resulted short in the ground in purple colour.</li></ul>
(ii)	<p>- Through using the laboratory medicine which can be used to reduce the nitrogen in the soil.</p> <p>- To introduce the fertilizer in the soil which is contains the alot of the nitrogen in the soil.</p>

11(b)(i)	<p>A it can represent the reaction of the oxygen and ethanol under which time the reaction to take place.</p> <p>- B and C it can represent the reaction it can take place at which in amount of degree in the allocated time</p>
(ii)	<p>The type of reaction is redox reaction in form of the oxygen and ethanol.</p>

In extract 11 the candidate provided responses which were completely out of intended facts. For example, in 11 (a)(ii) the candidate stated; “through using laboratory medicine” and to “introduce the fertilizers in the soil which contains a lot of nitrogen” as ways through which soil nitrogen can be lost. Likewise, in

11(b)(ii) instead of stating that the reaction was exothermic, he/she referred it as “neutrogenus reaction in form of oxygen and ethano”.

## **2.3 Section C: Essay Questions**

### **2.3.1 Question 12: Ionic Theory and Electrolysis; The Mole Concept and Related Calculations**

This was an essay type question in which a candidate was required to assume that he/she was a chemist in a chemical power plant that deals with the production of chlorine gas. The candidate was then asked to calculate the current of electricity to be passed in order to produce 100 litres of chlorine gas per hour so as to reach the company’s goal of producing 2400 litres every day.

This question was attempted by the least number (48.1 %) of candidates. Majority (89.8 %) of the candidates scored less than 4 out of 13 marks of which 36.8 percent scored a 0 mark. Only a few (2.9 %) scored above 6.5 of which 0.1 scored all 13 marks indicating an overall poor performance.

Majority of the candidates faced difficulties in integrating Faraday’s laws of electrolysis and mole concept (in Gas.Molar.Volume (GMV)) as the prerequisite of the question. A good number of them failed to correlate moles of electrons and quantity of electricity. i.e. 1 mole of electrons = 1faraday = 96500 coulombs and substitute the values in the discharge equation in order to get the quantity required to liberate one mole of chlorine. Failure to associate these values led to wrong calculations and hence incorrect responses.

In the other cases, the candidates were not able to write even a discharge equation which was necessary from which correlation could be made, hence failed to continue further. Such deficiencies are among the examples

which show that the candidates lacked the knowledge of these concepts or did not study them at all, and therefore resorted to write whatever on electricity, though irrelevant like that which is shown by Extract 12.1.

### Extract 12.1

12- For the plants growth there are used these are used such as chlorine gas. In order to increase the current of electricity in house, the following process must be taken.

To increase the capacity of voltage. In order to reduce the high speed of electricity the voltage must be increased in the current.

To reduce the resistance in the electricity. When the resistance is high so the amount of electricity is low and when the resistance is low the amount of electricity is high so the amount of resistivity of the materials will be reduced.

Also to use the materials that produce the high amount of the current. In order to reduce the high production of chlorine gas so the use of wire with produce the amount of electricity it is must be used.

Also to use the other gas such nitrogen that can help to produce the large amount of production.

How to use the good method of cultivation. This means that use the crop rotation from one year to another or from percae to another period.

Extract 12.2 shows a sample of a response of the candidate who wrote irrelevant points, contrary to the requirement of the question.

However, the candidates who scored high marks managed to write a correct discharge equation, they made correct manipulation of data and substituted

them into appropriate formula or relationship. Extract 12.2 is only a part of the work of a candidate who did well in question 12.

### Extract 12.2

12. from the first faraday's first law of electrolysis

$$M \propto Q$$

where  $Q$  = Quantity of charge  
 $m$  = mass of substance.

12.  $m = \frac{ArIt}{V \cdot f}$

Where  $Ar$  = relative atomic mass of element.  
 $I$  = current  
 $t$  = time  
 $V$  = valency of an element  
 $f$  = faraday's

remember that 1 hour = 3600 sec

$$I = \frac{316 \cdot 9449 \times 1 \times 96500}{35.5 \times 3600}$$

$$I = \frac{30585096}{127800}$$

$$I = 239.32 A$$

$\therefore$  The current of electricity will you allow to flow per hour is 239.32 A

In extract 12.1 the candidate presented accurate responses clearly according to the requirement of the question. He/she applied appropriate formulas to calculate the masses concerned and

incorporated them to calculate the current which was the required response.

### **2.3.2 Question 13: Pollution**

In this question, the candidates were required to describe five causes and effects of soil pollution.

The question was attempted by almost all (93.8 %) candidates and the majority (73.4 %) scored 4 or above out of 13 marks. The candidates who scored 4 to 6.5 marks were 32.5 percent and those who scored 7 to 10 marks were 34.6 percent. It was 26.6 percent who managed to score 0 to 3.5 percent while 8.3 percent managed to score 10.5 to 13 marks. Thus, the overall performance was good.

Candidates who scored high marks in this question managed to identify and describe both natural and human activities which contribute to soil erosion such as; mining activities, agricultural activities and acidic rain to mention a few. Moreover, they organized their work in a good logical order starting from; introduction, presentation of points and finally conclusion. Good performance signifies that, most candidates were comfortable with the question; probably because the concept about pollution is taught in other fields of study such as Geography and Biology though in different approaches. Moreover, since pollution is one of the global environmental cross-cutting issues, many organizations are involved in educating people about it and therefore, some candidates might have come across about the knowledge. Extract 13:1 shows some parts of a good response from one of the candidates.

### Extract 13:1

13 Pollution is the addition of harmful substances or material on land (soil), water or air which make them unfit for use. When talking about soil pollution, this is the act of making soil unfit for use. The following are the causes of soil pollution:-

Agrochemicals, these are chemicals from agricultural activities such as pesticides. When they are poorly applied to the soil they cause the soil to be less valuable to be used.

Improper domestic waste disposal: Domestic wastes such as sewage, plastic containers and cans if are not well disposed they contribute in polluting the soil, this is because the plastic materials are not decomposed by bacteria in the soil therefore they remain in the soil and cause it to be unfit for use.

.....  
Apart from those causes of soil pollution let us now look for its effects

Health problems, because soil is our most source of food production activities it has found that dangerous substances and chemicals from industries or else where used by plants and when this plants like maize and beans which are useful to human, are used they cause health problems like disease. Or this substances causes plant diseases and hence plants die.

.....  
.....  
We should avoid polluting our environment in order to be safe

Extract 13.1 is an example of a well presented response. The candidate had a very good essay with good introduction, good presentation of points and finally an impressive conclusion on the causes and effects of soil pollution.

Candidates who scored partial marks, managed to explain less than the required five causes of soil pollution, while some identified only the causes without explanation. On the other hand, a few candidates who performed poorly, particularly those who scored zero mark were unable to identify and elaborate even a single correct cause of soil pollution. In other cases it was noted that, candidates had low marks because they failed to express well their ideas in using English Language. Extract 13: 2 gives a sample of a response with a score of 00 marks.

### Extract 13: 2

13	Causes of Soil pollution
	Soil pollution: it is a very being poor of soil formation caused soil pollution it does not good of climate condition cause soil pollution it is a being poor of the features these are the causes of effect of soil pollution these are.
	Global warming: it is a source of the effect of soil pollution caused global warming that to increase a total of number of people from one to another place.
	Poor quality housing: these are the another effect of soil pollution because housing on the poor quality housing of the house these are the many causes or effects of soil pollution.

	Agriculture Sectors: are the another causes of Soil
	Pollution on the Agriculture Sectors Soil pollution it took
	place for another place, it to reduce on Agriculture becau
	se agriculture it is to affect on the area.
	Climate condition: that are the another effe
	ct of Soil pollution because Climate condition it is a
	bad poor or bec poor for climate and that are an effect
	of Soil.
	Increase of death: are the many effects
	of Soil pollution, Soil pollution these are a very bad
	poor. People we increase of death in our people
	on the Society.

In Extract 13.2 the candidate focused some of his/her points on causes of effects of soil pollution though irrelevant, instead of causes and effects of soil pollution which was the requirement of the question. Moreover, he/she was unable to construct correct sentences to explain his/her points.

### 3.0 CONCLUSION AND RECOMMENDATIONS

#### 3.1 Conclusion

The questionwise analysis of the performance in Chemistry 1 for the CSEE 2014 noted that, 4 questions had good performance, 2 questions had an average performance while 7 questions had poor performance. This indicates an average overall performance. Further analysis on how candidates performed in different topics is summarized in the Appendix.

According to the Appendix, Green colour is used to show topics which had good performance; Yellow shows topics which had average performance

while Red shows poor performed topics. The topics which were well performed were Laboratory Techniques and Safety; Extraction of Metals; Periodic Classification; Non-metals and their Compounds and Pollution which were examined in questions 3, 5 and 13. On the other hand, the topics which were the most poorly performed were Compounds of Metals; Matter (3.4%), The Mole Concept and Related Calculations (12.8%), Soil Chemistry; Chemical Kinetics, Equilibrium and Energetics (18.0%) and Ionic Theory and Electrolysis; The Mole Concept and Related Calculations (10.2%).

The analysis on individual items showed that, in addition, lack of sufficient knowledge on the concept tested, many candidates experienced difficulties in answering question items which involved translating and writing some chemical reactions into balanced chemical equations, like question 6. The further analysis showed that, most candidates experienced problem in questions which involved calculations based on chemistry principles, laws and formulas like questions 10 and 12. The candidates also had problems in interpretation of the requirement of the questions as observed in question 11. Moreover, others failed to present their points when answering examination questions due to poor mastery of English Language, example in questions 4 and 13.

The candidates' poor performance could be attributed to lack of both theoretical and practical experience in laboratory experiments which are important for the candidates to acquire chemistry skills, knowledge and principles. Other attribute could be inadequate preparation of students for mastering the subject. This trend needs to be alleviated by both teachers and students during the teaching and learning process.

It is expected that the feedback given in this report will enable the stakeholders to take immediate and appropriate measures to improve the performance of candidates in CSEE in Chemistry, taking into account that the subject forms a base for science subjects' combinations in ACSE level.

### **3.2 Recommendations**

In view of the analysis and conclusion made on the performance in Chemistry 1 CSEE 2014, it is recommended that:-

- (a) During instructions, teachers should spare time to enable students to learn basic concepts involving rules and principles governing all topics in chemistry.
- (b) Teachers should emphasize on frequent revision of all topics in the syllabus.
- (c) Prospective candidates should be enhanced to master English Language so as to be able to follow class instructions and answer the examination questions.
- (d) Students should be given enough laboratory experiments/learn by doing, monitored and product evaluated so as to help them master the subject.
- (e) Candidates should be taught meanings of various instructional terms such as describe, state, explain, discuss and the likes, so as to use them accordingly, during examinations.

**ANALYSIS OF CANDIDATES' PERFORMANCE PER TOPIC IN  
032/1 CHEMISTRY 1 FOR SCHOOL CANDIDATES**

S/N	TOPIC	QUESTION NUMBER	THE % OF CANDIDATES WHO SCORED AN AVERAGE OF 30 % OR ABOVE	REMARKS
1.	Laboratory Techniques and Safety; Extraction of Metals	3	78.3	Good
2.	Periodic Classification; Non-metals and their Compounds	5	74.4	Good
3.	Periodic Classification; Chemical Equations; Acids, Bases and Salts; Matter; Ionic Theory and Electrolysis; Volumetric Analysis; Extraction of metals, The Mole Concept & Related Calculations, Organic Chemistry; Chemical Kinetics, Equilibrium and Energetics.	1	73.7	Good
4.	Pollution	13	73.4	Good
5.	Volumetric Analysis and Matter	4	43.0	Average
6.	Acids, Bases and Salts; Formula Bonding and Nomenclature	9	43.4	Average
7.	Compounds of Metals, Periodic Classification; Hydrogen; Non-metals and their Compounds; Extraction of Metals	2	27.0	Weak
8.	Hardness of Water; Chemical Equations	7	26.8	Weak
9.	Organic Chemistry, Non-metals their Compounds	8	22.6	Weak
10.	Soil Chemistry; Chemical Kinetics, Equilibrium Energetics	11	18.0	Weak
11.	The Mole Concept & Related Calculations	10	12.8	Weak
12.	Ionic Theory and Electrolysis; The Mole Concept & Related Calculations	12	10.2	Weak
13.	Compounds of Metals; Matter	6	3.4	Weak

